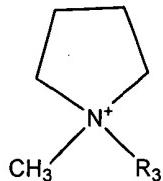
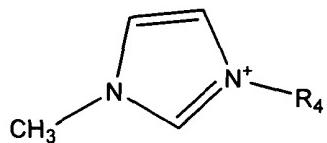


WHAT IS CLAIMED IS:

1. An electrolyte solution having a Tg of less than about -40°C, comprising at least one bifunctional redox dye dissolved in ionic liquid solvent.
2. The electrolyte solution of claim 1, wherein said bifunctional redox dye comprises at least one redox active anodic moiety and at least one redox active cathodic moiety.
3. The electrolyte solution of claim 1, wherein said bifunctional redox dye comprises at least one energy receptor moiety and at least one redox active anodic moiety, at least one energy receptor moiety and at least one redox active cathodic moiety, or at least one energy receptor moiety and at least one redox active anodic moiety and at least one redox active cathodic moiety.  
5
4. The electrolyte solution of claim 1, wherein said ionic liquid solvent comprises at least one cation selected from the group consisting of lithium cation and quaternary ammonium cations, wherein said quaternary ammonium cations are selected from the group consisting of pyridinium, pyridazinium, pyrimidinium, pyrazinium, imidazolium, pyrazolium, thiazolium, oxazolium, triazolium, tetraalkylammonium, N-methyl morpholinium, cations of the formula  $[(CH_3CH_2)_3N(R_1)]^+$ , wherein R<sub>1</sub> is alkyl having 2-10 carbons, cations of the formula  $[(CH_3)_2(CH_3CHCH_3)N(R_2)]^+$ , wherein R<sub>2</sub> is alkyl having 2-10 carbons, cations having the structural formula  
5



10 wherein R<sub>3</sub> is alkyl having 2-10 carbons, and cations having the structural formula

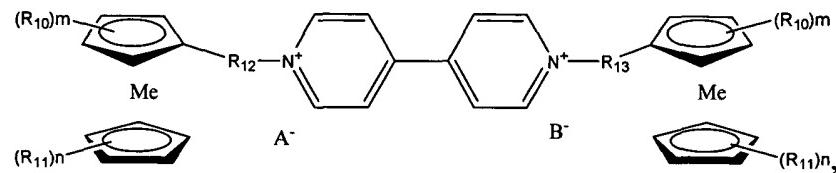


wherein R<sub>4</sub> is alkyl having 2-10 carbons.

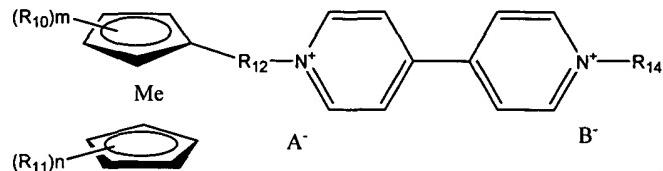
5. The electrolyte solution of claim 1, wherein said ionic liquid comprises at least one anion selected from the group consisting of trifluoromethylsulfonate ( $\text{CF}_3\text{SO}_3^-$ ), bis(trifluoromethylsulfonyl)imide ( $(\text{CF}_3\text{SO}_2)_2\text{N}^-$ ), bis(perfluoroethylsulfonyl)imide ( $(\text{CF}_3\text{CF}_2\text{SO}_2)_2\text{N}^-$ ) and tris(trifluoromethylsulfonyl)methide ( $(\text{CF}_3\text{SO}_2)_3\text{C}^-$ ).

6. The electrolyte solution of claim 2, wherein said anodic moiety of said bifunctional redox dye comprises a pyrazoline, metallocene, phenylenediamine, benzidine, phenoxadine, phenothiazine, tetrafulvalene or phenazine, and said cathodic moiety of said bifunctional redox dye comprises a viologen or anthraquinone.

7. The electrolyte solution of claim 1, wherein said bifunctional redox dye is a compound having the structural formula

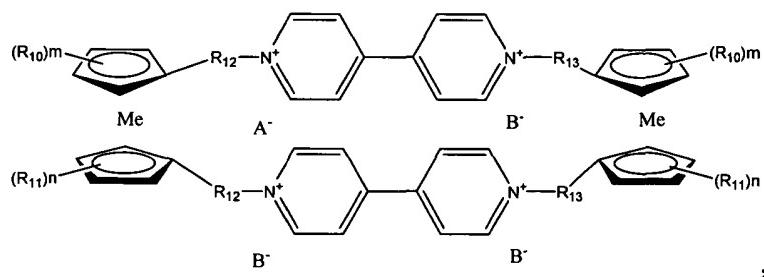


or having the structural formula



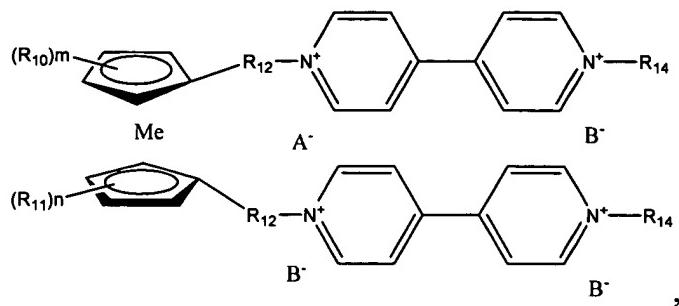
5

or having the structural formula



or having the structural formula

61



- 10 wherein  $\text{A}^-$  is selected from the group consisting of trifluoromethylsulfonate ( $\text{CF}_3\text{SO}_3^-$ ), bis(trifluoromethylsulfonyl)imide ( $(\text{CF}_3\text{SO}_2)_2\text{N}^-$ ), bis(perfluoroethylsulfonyl)imide ( $(\text{CF}_3\text{CF}_2\text{SO}_2)_2\text{N}^-$ ) and tris(trifluoromethylsulfonyl)methide ( $(\text{CF}_3\text{SO}_2)_3\text{C}^-$ );  $\text{B}^-$  is selected from the group consisting of a halogen anion,  $\text{ClO}_4^-$ ,  $\text{BF}_4^-$ ,  $\text{PF}_6^-$ ,  $\text{AsF}_6^-$ ,  $\text{SbF}_6^-$ ,  $\text{CH}_3\text{COO}^-$ , and  $\text{CH}_3(\text{C}_6\text{H}_4)\text{SO}_3^-$ , trifluoromethylsulfonate ( $\text{CF}_3\text{SO}_3^-$ ), bis(trifluoromethylsulfonyl)imide ( $(\text{CF}_3\text{SO}_2)_2\text{N}^-$ ), bis(perfluoroethylsulfonyl)imide ( $(\text{CF}_3\text{CF}_2\text{SO}_2)_2\text{N}^-$ ) and tris(trifluoromethylsulfonyl)methide ( $(\text{CF}_3\text{SO}_2)_3\text{C}^-$ ); wherein  $\text{R}_{10}$  and  $\text{R}_{11}$  are each independently a hydrocarbon group selected from the group consisting of an alkyl, alkenyl and aryl group having 1 to 10 carbon atoms, in the case where  $\text{R}_{10}$  or  $\text{R}_{11}$  is an aryl group, the aryl group forms a condensed ring together with a cyclopentadienyl ring; wherein  $m=0-4$ ; wherein  $n=0-4$ ; wherein  $\text{R}_{12}$  and  $\text{R}_{13}$  are each independently a hydrocarbon residue having 1 to 20 carbon atoms, or alkylene groups having ester-bond unit, ether-bond unit, amide-bond unit, thioether-bond unit, amine-bond unit, urethane-bond unit, or silyl unit in the part of hydrocarbon groups, and  $\text{R}_{14}$  is a hydrocarbon group selected from the group consisting of an alkyl, cycloalkyl, alkenyl, aryl, or aralkyl group having 1 to 20 carbon atoms, a heterocyclic group having 4 to 20 carbon atoms, and a substituted hydrocarbon or heterocyclic group obtained by substituting part of hydrogens of the hydrocarbon group or heterocyclic group with a substituent group; and  $\text{Me}$  represents  $\text{Cr}$ ,  $\text{Co}$ ,  $\text{Fe}$ ,  $\text{Mn}$ ,  $\text{Ni}$ ,  $\text{Os}$ ,  $\text{Ru}$ ,  $\text{V}$ ,  $\text{Mo}(\text{X})(\text{Q})$ ,  $\text{Nb}(\text{X})(\text{Q})$ ,  $\text{Ti}(\text{X})(\text{Q})$ ,  $\text{V}(\text{X})(\text{Q})$  or  $\text{Zr}(\text{X})(\text{Q})$  wherein  $\text{X}$  and  $\text{Q}$  are each independently selected from the group consisting of hydrogen, halogen, an alkyl group having 1 to 12 carbon atoms,  $\text{ClO}_4^-$ ,  $\text{BF}_4^-$ ,  $\text{PF}_6^-$ ,  $\text{AsF}_6^-$ ,  $\text{SbF}_6^-$ ,  $\text{CH}_3\text{COO}^-$ ,  $\text{CH}_3(\text{C}_6\text{H}_4)\text{SO}_3^-$ , trifluoromethylsulfonate ( $\text{CF}_3\text{SO}_3^-$ ), bis(trifluoromethylsulfonyl)imide ( $(\text{CF}_3\text{SO}_2)_2\text{N}^-$ ), bis(perfluoroethylsulfonyl)imide ( $(\text{CF}_3\text{CF}_2\text{SO}_2)_2\text{N}^-$ ) and tris(trifluoromethylsulfonyl)methide ( $(\text{CF}_3\text{SO}_2)_3\text{C}^-$ );

or having the formula

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Cat<sub>1</sub>-An<sub>1</sub>,

or having the formula

Cat<sub>1</sub>-Bridge<sub>1</sub>-An<sub>1</sub>,

or having the formula

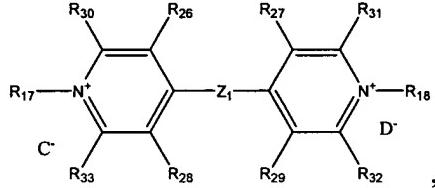
Cat<sub>1</sub>-Bridge<sub>1</sub>-An<sub>1</sub>-Bridge<sub>2</sub>-Cat<sub>2</sub>,

40 or having the formula

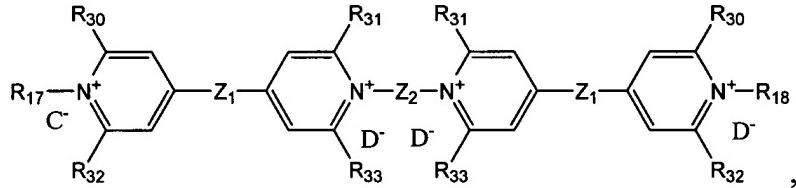
An<sub>2</sub>-Bridge<sub>2</sub>-Cat<sub>1</sub>-Bridge<sub>1</sub>-An<sub>1</sub>,

wherein Cat<sub>1</sub>-An<sub>1</sub> represents a charge transfer complex;

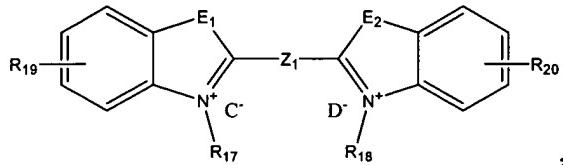
wherein Cat<sub>1</sub> and Cat<sub>2</sub> independently represent a radical having the structural formula



45 or having the structural formula

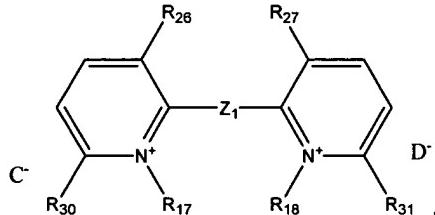


or having the structural formula



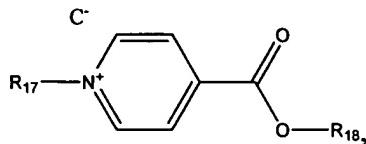
or having the structural formula

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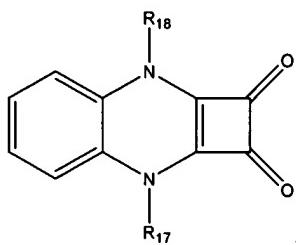


or having the structural formula

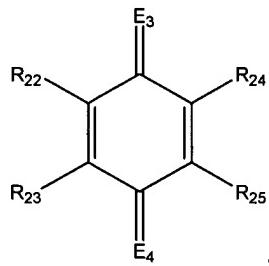
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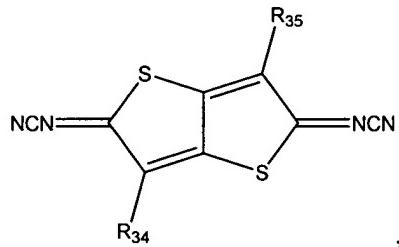
or having the structural formula



55 or having the structural formula



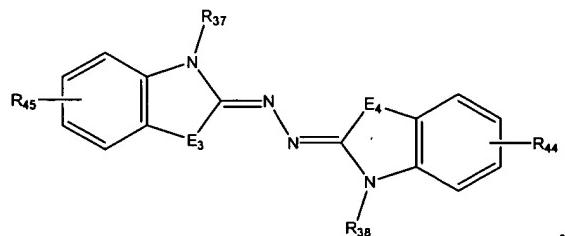
or having the structural formula



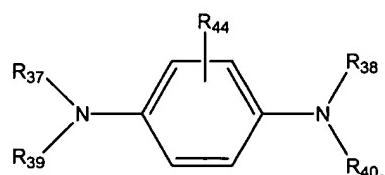
wherein R<sub>17</sub> and R<sub>18</sub> independently of one another denote C<sub>1</sub> to C<sub>18</sub>-alkyl, C<sub>2</sub> to C<sub>12</sub>-alkenyl, C<sub>3</sub> to C<sub>7</sub>-cycloalkyl, C<sub>7</sub> to C<sub>15</sub>-aralkyl or C<sub>6</sub> to C<sub>10</sub>-aryl or R<sub>17</sub> and R<sub>18</sub> together form a -(CH<sub>2</sub>)<sub>2</sub>-, -(CH<sub>2</sub>)<sub>3</sub>-, or -CH=CH- bridge, R<sub>19</sub>, R<sub>20</sub> and R<sub>22</sub> to R<sub>25</sub> independently of one another denote hydrogen, C<sub>1</sub> to C<sub>18</sub>-alkyl, C<sub>1</sub> to C<sub>4</sub>-alkoxy, halogen, cyano, nitro or C<sub>1</sub> to C<sub>18</sub>-alkoxycarbonyl or R<sub>22</sub> and R<sub>23</sub> and/or R<sub>24</sub> and R<sub>25</sub> form a -CH=CH-CH=CH-bridge; R<sub>26</sub>, R<sub>27</sub>, R<sub>28</sub> and R<sub>29</sub> independently of one another denote hydrogen or, in pairs, a -(CH<sub>2</sub>)<sub>2</sub>-, -(CH<sub>2</sub>)<sub>3</sub>- or -CH=CH- bridge, E<sub>3</sub> and E<sub>4</sub> independently of one another denote O, N-CN, C(CN)<sub>2</sub> or N-C<sub>6</sub>- to C<sub>10</sub>-aryl, R<sub>34</sub> and R<sub>35</sub> independently denote hydrogen, C<sub>1</sub> to C<sub>18</sub>-alkyl, C<sub>1</sub> to C<sub>18</sub>-alkoxy, halogen, cyano, nitro, C<sub>1</sub> to C<sub>18</sub>-alkoxycarbonyl or C<sub>6</sub> to C<sub>10</sub>-alkenyl.

aryl, R<sub>30</sub> to R<sub>33</sub> independently of one another denote hydrogen or C<sub>1</sub> to C<sub>6</sub>-alkyl, or R<sub>30</sub> and R<sub>26</sub> and/or R<sub>31</sub> and R<sub>27</sub> form a -CH=CH-CH=CH- bridge, E<sub>1</sub> and E<sub>2</sub> independently of 70 one another denote O, S, NR<sub>36</sub> or C(R<sub>36</sub>)<sub>2</sub> or E<sub>1</sub> and E<sub>2</sub> together form a -N-(CH<sub>2</sub>)<sub>2</sub>-N- bridge, R<sub>36</sub> denotes C<sub>1</sub> to C<sub>18</sub>-alkyl, C<sub>2</sub> to C<sub>12</sub>-alkenyl, C<sub>4</sub> to C<sub>7</sub>-cycloalkyl, C<sub>7</sub> to C<sub>15</sub>- aralkyl or C<sub>6</sub> to C<sub>10</sub>-aryl, Z<sub>1</sub> denotes a direct bond, -CH=CH-, -C(CH<sub>3</sub>)=CH-, -C(CN)=CH-, -CCl=CCl-, -C(OH)=CH-, -CCl=CH-, -C≡C-, -CH=N-N=CH-, -C(CH<sub>3</sub>)=N- N=C(CH<sub>3</sub>)- or -CCl=N-N=CCl-, Z<sub>2</sub> denotes -(CH<sub>2</sub>)<sub>r</sub> or -CH<sub>2</sub>-C<sub>6</sub>H<sub>4</sub>-CH<sub>2</sub>-, r=1-10, C<sup>-</sup> is 75 selected from the group consisting of bis(trifluoromethylsulfonyl)imide ((CF<sub>3</sub>SO<sub>2</sub>)<sub>2</sub>N<sup>-</sup>), bis(perfluoroethylsulfonyl)imide ((CF<sub>3</sub>CF<sub>2</sub>SO<sub>2</sub>)<sub>2</sub>N<sup>-</sup>) and tris(trifluoromethylsulfonyl)methide ((CF<sub>3</sub>SO<sub>2</sub>)<sub>3</sub>C<sup>-</sup>), and D<sup>-</sup> is selected from the group 80 consisting of halogen anion, ClO<sub>4</sub><sup>-</sup>, BF<sub>4</sub><sup>-</sup>, PF<sub>6</sub><sup>-</sup>, AsF<sub>6</sub><sup>-</sup>, SbF<sub>6</sub><sup>-</sup>, CH<sub>3</sub>COO<sup>-</sup>, and CH<sub>3</sub>(C<sub>6</sub>H<sub>4</sub>)SO<sub>3</sub><sup>-</sup>, trifluoromethylsulfonate (CF<sub>3</sub>SO<sub>3</sub><sup>-</sup>), bis(trifluoromethylsulfonyl)imide ((CF<sub>3</sub>SO<sub>2</sub>)<sub>2</sub>N<sup>-</sup>), bis(perfluoroethylsulfonyl)imide ((CF<sub>3</sub>CF<sub>2</sub>SO<sub>2</sub>)<sub>2</sub>N<sup>-</sup>) and tris(trifluoromethylsulfonyl)methide ((CF<sub>3</sub>SO<sub>2</sub>)<sub>3</sub>C<sup>-</sup>), wherein bonding to the bridge member bridge<sub>1</sub> or bridge<sub>2</sub> is effected via one of the radicals R<sub>17</sub>-R<sub>36</sub>, and the radicals mentioned then represent a direct bond, and wherein An<sub>1</sub> and An<sub>2</sub> independently represent radicals having the structural formula:

85



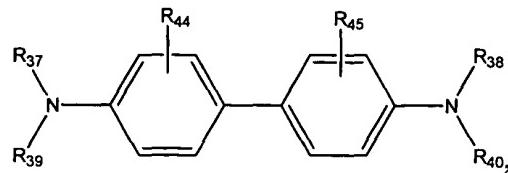
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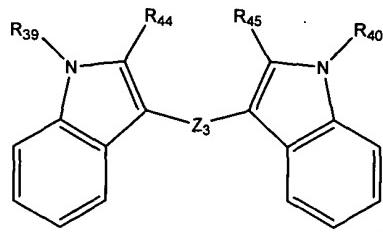
or having the structural formula

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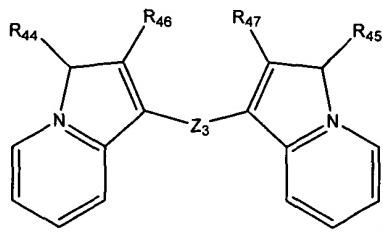
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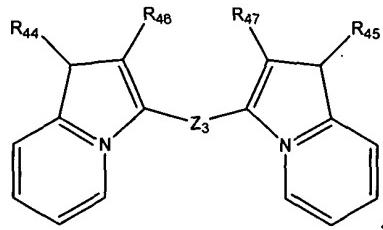
or having the structural formula



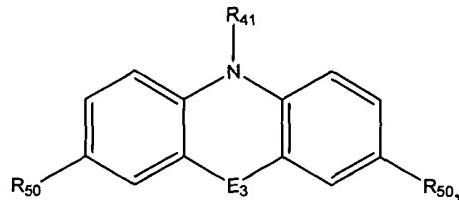
or having the structural formula



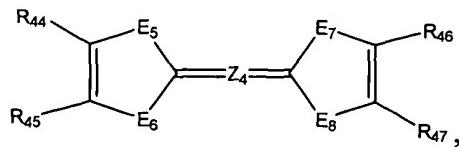
95 or having the structural formula



or having the structural formula

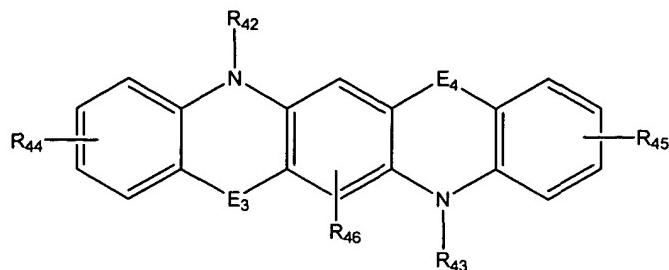


or having the structural formula



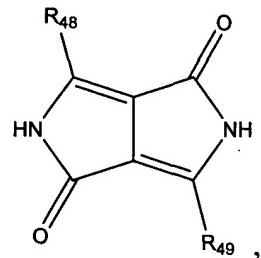
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or having the structural formula



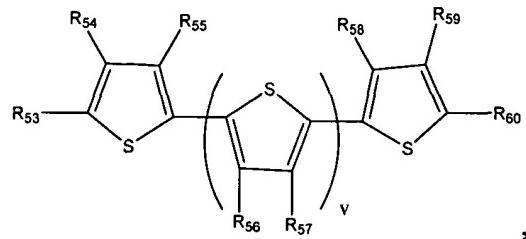
,

or having the structural formula



,

105 or having the structural formula



,

or wherein  $A_{n1}$  or  $A_{n2}$  independently represent a metal salt comprising titanium (III), vanadium (III), vanadium (IV), iron (II), cobalt (II), copper (I), silver (I), indium (I), tin (II), antimony (III), bismuth (III), cerium (III), samarium (II), dysprosium (II), ytterbium (II), or europium (II), wherein  $R_{37}$  to  $R_{43}$  independently of one another denote  $C_1$  to  $C_{18}$ -alkyl,  $C_2$  to  $C_{12}$ -alkenyl,  $C_3$  to  $C_7$ -cycloalkyl,  $C_7$  to  $C_{15}$ -aralkyl or  $C_6$  to  $C_{10}$ -aryl, and  $R_{41}$  to  $R_{43}$  additionally denote hydrogen,  $R_{44}$  to  $R_{50}$  independently of one another denote hydrogen,  $C_1$  to  $C_{18}$ -alkyl,  $C_1$  to  $C_{18}$ -alkoxy, halogen, cyano, nitro,  $C_1$  to  $C_{18}$ -alkoxycarbonyl or  $C_6$  to  $C_{10}$ -aryl and  $R_{48}$  and  $R_{49}$  additionally denote an optionally benzo-fused aromatic or quasiaromatic five- or six-membered heterocyclic ring and  $R_{50}$  additionally independently denotes  $N(R_{51})(R_{52})$ ,  $R_{44}$  and  $R_{45}$  and/or  $R_{46}$  and  $R_{47}$  form a- $(CH_2)_3$ -,  $-(CH_2)_4$ -,  $-(CH_2)_5$ - or  $-CH=CH-CH=CH-$  bridge,  $Z_3$  denotes a direct bond or a- $CH=CH-$  or  $-N=N-$  bridge,  $=Z_4=$  denotes a direct double bond or a  $=CH-CH=$  or  $=N-N=$

bridge, E<sub>3</sub> and E<sub>4</sub> independently of one another denote O, S, NR<sub>51</sub>, C(R<sub>51</sub>)(R<sub>52</sub>), C=O or SO<sub>2</sub>, E<sub>5</sub> to E<sub>8</sub> independently of one another denote S, Se or NR<sub>51</sub>, R<sub>51</sub> and R<sub>52</sub> independently of one another denote C<sub>1</sub> to C<sub>12</sub>-alkyl, C<sub>2</sub> to C<sub>8</sub>-alkenyl, C<sub>3</sub> to C<sub>7</sub>-cycloalkyl, C<sub>7</sub> to C<sub>15</sub>-aralkyl or C<sub>6</sub> to C<sub>10</sub>-aryl, R<sub>53</sub> to R<sub>60</sub> independently of one another denote hydrogen, C<sub>1</sub>- to C<sub>6</sub>-alkyl, C<sub>1</sub> to C<sub>18</sub>-alkoxy, cyano, C<sub>1</sub> to C<sub>18</sub>-alkoxycarbonyl or C<sub>6</sub> to C<sub>10</sub>-aryl, or R<sub>53</sub> and R<sub>54</sub> and R<sub>59</sub> and R<sub>60</sub> independently of one another together form a -(CH<sub>2</sub>)<sub>3</sub>-, -(CH<sub>2</sub>)<sub>4</sub>- or -CH=CH-CH=CH- bridge, v=0-10, wherein bonding to the bridge member Bridge<sub>1</sub> or Bridge<sub>2</sub> is effected by one of the radicals R<sub>37</sub>-R<sub>54</sub>, or R<sub>60</sub> and the radicals mentioned then represent a direct bond, and Bridge<sub>1</sub> or Bridge<sub>2</sub> independently represents a bridge member of the formula -(CH<sub>2</sub>)<sub>n</sub>- or -(Y<sub>1</sub>)<sub>s</sub>(CH<sub>2</sub>)<sub>m</sub>-(Y<sub>2</sub>)<sub>o</sub>-(CH<sub>2</sub>)<sub>p</sub>-(Y<sub>3</sub>)<sub>q</sub>- each of which is optionally substituted by C<sub>1</sub> to C<sub>18</sub>-alkoxy, halogen or phenyl, Y<sub>1</sub> to Y<sub>3</sub> independently of one another independently represent O, S, NR<sub>61</sub>, COO, CONH, NHCONH, cyclopentanediyl, cyclohexanediyl, phenylene or naphthylene, beta-dicarbonyls, R<sub>61</sub> denotes C<sub>1</sub> to C<sub>6</sub>-alkyl, C<sub>2</sub> to C<sub>6</sub>-alkenyl, C<sub>4</sub> to C<sub>7</sub>-cycloalkyl, C<sub>7</sub> to C<sub>15</sub>-aralkyl or C<sub>6</sub>- to C<sub>10</sub>-aryl, n=0-12, m=0-8, o=0-12, p=0-12, q=0-1, and s=0-1.

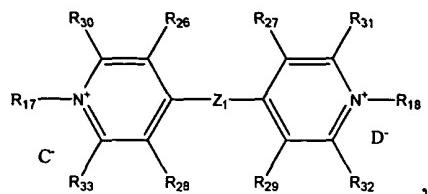
8. The electrolyte solution of claim 3, wherein said bifunctional redox dye comprises a redox active moiety comprising a pyrazoline, metallocene, phenylenediamine, benzidine, phenoxydine, phenothiazine, tetrafulvalene, phenazine, viologen or anthraquinone, and an energy receptor moiety comprising a benzophenone, benzotraizole, or cyanoacrylate.

9. The electrolyte solution of claim 1, wherein said bifunctional redox dye comprises a compound having the formula

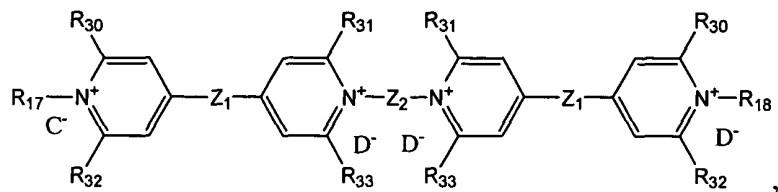


wherein M represents a metal salt comprising titanium (III), vanadium (III), vanadium (IV), iron (II), cobalt (II), copper (I), silver (I), indium (I), tin (II), antimony (III), bismuth (III), cerium (III), samarium (II), dysprosium (II), ytterbium (II), or europium (II); wherein Cat<sub>1</sub> represents a ligand having the structural formula

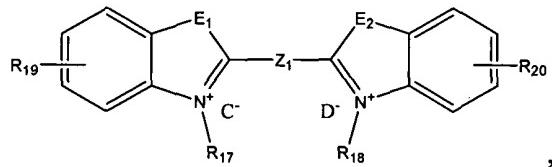
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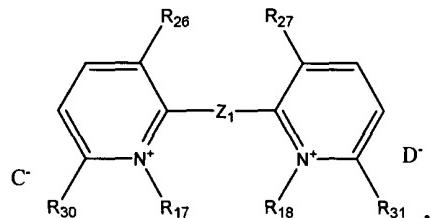
10 or having the structural formula



or having the structural formula

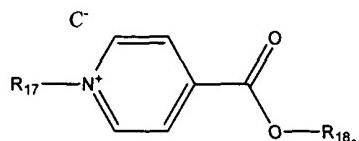


or having the structural formula

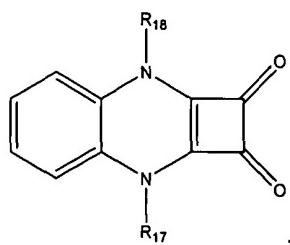


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or having the structural formula

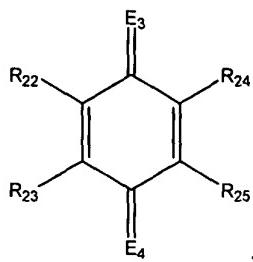


or having the structural formula



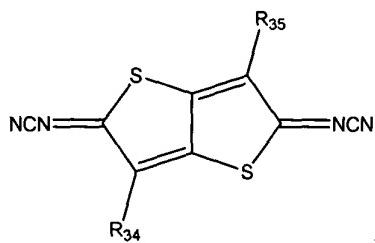
20 or having the structural formula

69



,

or having the structural formula



,

- wherein R<sub>17</sub> and R<sub>18</sub> independently of one another denote C<sub>1</sub> to C<sub>18</sub>-alkyl, C<sub>2</sub> to C<sub>12</sub>-alkenyl, C<sub>3</sub> to C<sub>7</sub>-cycloalkyl, C<sub>7</sub> to C<sub>15</sub>-aralkyl or C<sub>6</sub> to C<sub>10</sub>-aryl or R<sub>17</sub> and R<sub>18</sub> together form a -(CH<sub>2</sub>)<sub>2</sub>-, -(CH<sub>2</sub>)<sub>3</sub>-, or -CH=CH-, R<sub>19</sub>, R<sub>20</sub> and R<sub>22</sub> to R<sub>25</sub> independently of one another denote hydrogen, C<sub>1</sub> to C<sub>18</sub>-alkyl, C<sub>1</sub> to C<sub>18</sub>-alkoxy, halogen, cyano, nitro or C<sub>1</sub> to C<sub>18</sub>-alkoxycarbonyl or R<sub>22</sub> and R<sub>23</sub> and/or R<sub>24</sub> and R<sub>25</sub> form a -CH=CH-CH=CH- bridge; R<sub>26</sub>, R<sub>27</sub>, R<sub>28</sub> and R<sub>29</sub> independently of one another denote hydrogen or, in pairs, a -(CH<sub>2</sub>)<sub>2</sub>-, -(CH<sub>2</sub>)<sub>3</sub>- or -CH=CH- bridge, E<sub>3</sub> and E<sub>4</sub> independently of one another denote O, N-CN, C(CN)<sub>2</sub> or N-C<sub>6</sub>- to C<sub>10</sub>-aryl, R<sub>34</sub> and R<sub>35</sub> independently denote hydrogen, C<sub>1</sub> to C<sub>18</sub>-alkyl, C<sub>1</sub> to C<sub>18</sub>-alkoxy, halogen, cyano, nitro, C<sub>1</sub> to C<sub>18</sub>-alkoxycarbonyl or C<sub>6</sub> to C<sub>10</sub>-aryl, R<sub>30</sub> to R<sub>33</sub> independently of one another denote hydrogen or C<sub>1</sub>-C<sub>6</sub>-alkyl, or R<sub>30</sub> and R<sub>26</sub> and/or R<sub>31</sub> and R<sub>27</sub> form a -CH=CH-CH=CH- bridge, E<sub>1</sub> and E<sub>2</sub> independently of one another denote O, S, NR<sub>36</sub> or C(R<sub>36</sub>)<sub>2</sub> or E<sub>1</sub> and E<sub>2</sub> together form a -N-(CH<sub>2</sub>)<sub>2</sub>-N- bridge, R<sub>36</sub> denotes C<sub>1</sub> to C<sub>18</sub>-alkyl, C<sub>2</sub> to C<sub>12</sub>-alkenyl, C<sub>4</sub> to C<sub>7</sub>-cycloalkyl, C<sub>7</sub> to C<sub>15</sub>-aralkyl or C<sub>6</sub> to C<sub>10</sub>-aryl, Z<sub>1</sub> denotes a direct bond, -CH=CH-, -C(CH<sub>3</sub>)=CH-, -C(CN)=CH-, -CCl=CCl-, -C(OH)=CH-, -CCl=CH-, -C≡C-, -CH=N-N=CH-, -C(CH<sub>3</sub>)=N-N=C(CH<sub>3</sub>)- or -CCl=N-N=CCl-, Z<sub>2</sub> denotes -(CH<sub>2</sub>)<sub>r</sub> or -CH<sub>2</sub>-C<sub>6</sub>H<sub>4</sub>-CH<sub>2</sub>-, r=1-10, C<sup>-</sup> is selected from the group consisting of bis(trifluoromethylsulfonyl)imide ((CF<sub>3</sub>SO<sub>2</sub>)<sub>2</sub>N<sup>-</sup>), bis(perfluoroethylsulfonyl)imide ((CF<sub>3</sub>CF<sub>2</sub>SO<sub>2</sub>)<sub>2</sub>N<sup>-</sup>) and tris(trifluoromethylsulfonyl)methide ((CF<sub>3</sub>SO<sub>2</sub>)<sub>3</sub>C<sup>-</sup>), and D<sup>-</sup> is selected from the group

consisting of halogen anion,  $\text{ClO}_4^-$ ,  $\text{BF}_4^-$ ,  $\text{PF}_6^-$ ,  $\text{AsF}_6^-$ ,  $\text{SbF}_6^-$ ,  $\text{CH}_3\text{COO}^-$ , and  $\text{CH}_3(\text{C}_6\text{H}_4)\text{SO}_3^-$ , trifluoromethylsulfonate ( $\text{CF}_3\text{SO}_3^-$ ), bis(trifluoromethylsulfonyl)imide

45 (( $\text{CF}_3\text{SO}_2)_2\text{N}^-$ ), bis(perfluoroethylsulfonyl)imide (( $\text{CF}_3\text{CF}_2\text{SO}_2)_2\text{N}^-$ ) and tris(trifluoromethylsulfonyl)methide (( $\text{CF}_3\text{SO}_2)_3\text{C}^-$ ).

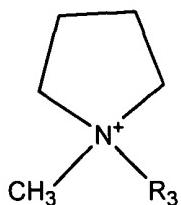
10. The electrolyte solution claim 1, further comprising at least one additive selected from the group consisting of non-ionic cosolvents, polymers, thixotropic agents, and UV stabilizers.

11. An electro-optic device comprising at least one chamber and, as the electrolyte medium inside the chamber, an electrolyte solution having a  $T_g$  of less than about  $-40^\circ\text{C}$  and comprising at least one bifunctional redox dye dissolved in an ionic liquid solvent.

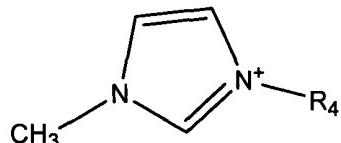
12. The electro-optic device of claim 11, wherein said bifunctional redox dye comprises at least one redox active anodic moiety and at least one redox active cathodic moiety.

13. The electro-optic device of claim 11, wherein said bifunctional redox dye comprises at least one energy receptor moiety and at least one redox active anodic moiety, at least one energy receptor moiety and at least one redox active cathodic moiety, or at least one energy receptor moiety and at least one redox active anodic moiety and at least one redox active cathodic moiety.

5 14. The electro-optic device of claim 11, wherein said ionic liquid comprises at least one cation selected from the group consisting of lithium cation and quaternary ammonium cations, wherein said quaternary ammonium cations are selected from the group consisting of pyridinium, pyridazinium, pyrimidinium, pyrazinium, imidazolium, pyrazolium, thiazolium, oxazolium, triazolium, tetraalkylammonium, N-methyl morpholinium, cations of the formula  $[(\text{CH}_3\text{CH}_2)_3\text{N}(\text{R}_1)]^+$ , wherein  $\text{R}_1$  is alkyl having 2-10 carbons, cations of the formula  $[(\text{CH}_3)_2(\text{CH}_3\text{CHCH}_3)\text{N}(\text{R}_2)]^+$ , wherein  $\text{R}_2$  is alkyl having 2-10 carbons, cations having the structural formula



10 wherein R<sub>3</sub> is alkyl having 2-10 carbons, and cations having the structural formula

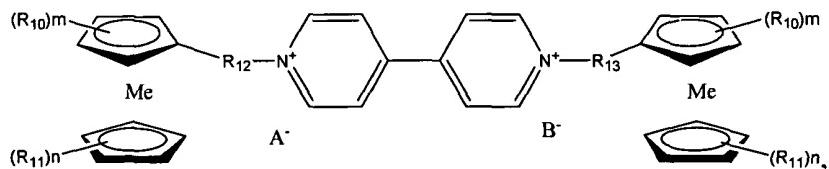


wherein R<sub>4</sub> is alkyl having 2-10 carbons.

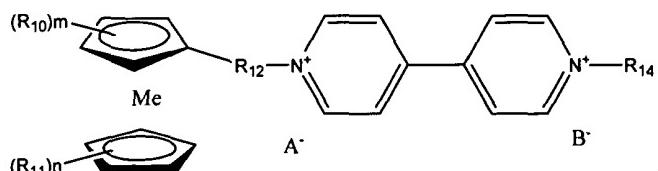
15. The electro-optic device of claim 11, wherein said ionic liquid comprises at least one anion selected from the group consisting of trifluoromethylsulfonate (CF<sub>3</sub>SO<sub>3</sub><sup>-</sup>), bis(trifluoromethylsulfonyl)imide ((CF<sub>3</sub>SO<sub>2</sub>)<sub>2</sub>N<sup>+</sup>), bis(perfluoroethylsulfonyl)imide ((CF<sub>3</sub>CF<sub>2</sub>SO<sub>2</sub>)<sub>2</sub>N<sup>+</sup>) and tris(trifluoromethylsulfonyl)methide ((CF<sub>3</sub>SO<sub>2</sub>)<sub>3</sub>C<sup>+</sup>).

16. The electro-optic device of claim 12, wherein said anodic moiety of said bifunctional redox dye comprises a pyrazoline, metallocene, phenylenediamine, benzidine, phenoxadine, phenothiazine, tetrafulvalene or phenazine, and said cathodic moiety of said bifunctional redox dye comprises a viologen or anthraquinone.

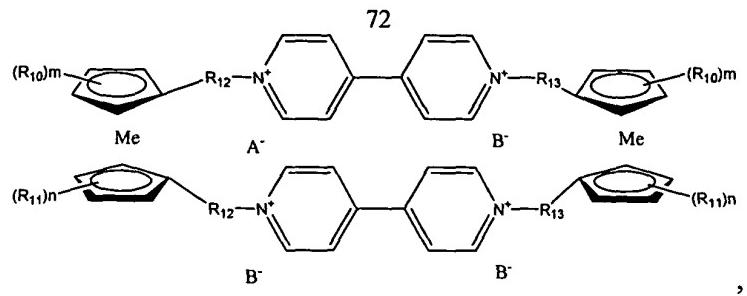
17. The electro-optic device of claim 11, wherein said bifunctional redox dye is a compound having the structural formula



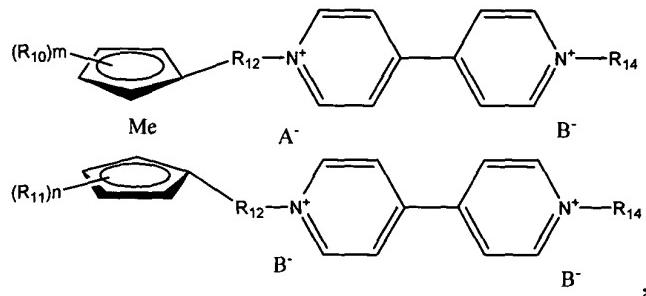
or having the structural formula



or having the structural formula



or having the structural formula



- 10 wherein A<sup>-</sup> is selected from the group consisting of trifluoromethylsulfonate (CF<sub>3</sub>SO<sub>3</sub><sup>-</sup>), bis(trifluoromethylsulfonyl)imide ((CF<sub>3</sub>SO<sub>2</sub>)<sub>2</sub>N<sup>-</sup>), bis(perfluoroethylsulfonyl)imide ((CF<sub>3</sub>CF<sub>2</sub>SO<sub>2</sub>)<sub>2</sub>N<sup>-</sup>) and tris(trifluoromethylsulfonyl)methide ((CF<sub>3</sub>SO<sub>2</sub>)<sub>3</sub>C<sup>-</sup>); B<sup>-</sup> is selected from the group consisting of a halogen anion, ClO<sub>4</sub><sup>-</sup>, BF<sub>4</sub><sup>-</sup>, PF<sub>6</sub><sup>-</sup>, AsF<sub>6</sub><sup>-</sup>, SbF<sub>6</sub><sup>-</sup>, CH<sub>3</sub>COO<sup>-</sup>, and CH<sub>3</sub>(C<sub>6</sub>H<sub>4</sub>)SO<sub>3</sub><sup>-</sup>, trifluoromethylsulfonate (CF<sub>3</sub>SO<sub>3</sub><sup>-</sup>), bis(trifluoromethylsulfonyl)imide ((CF<sub>3</sub>SO<sub>2</sub>)<sub>2</sub>N<sup>-</sup>), bis(perfluoroethylsulfonyl)imide ((CF<sub>3</sub>CF<sub>2</sub>SO<sub>2</sub>)<sub>2</sub>N<sup>-</sup>) and tris(trifluoromethylsulfonyl)methide ((CF<sub>3</sub>SO<sub>2</sub>)<sub>3</sub>C<sup>-</sup>); wherein R<sub>10</sub> and R<sub>11</sub> are each independently a hydrocarbon group selected from the group consisting of an alkyl, alkenyl and aryl group having 1 to 10 carbon atoms, in the case where R<sub>10</sub> or R<sub>11</sub> is an aryl group, the aryl group forms a condensed ring together with a cyclopentadienyl ring; wherein m=0-4; wherein n=0-4; wherein R<sub>12</sub> and R<sub>13</sub> are each independently a hydrocarbon residue having 1 to 20 carbon atoms, or alkylene groups having ester-bond unit, ether-bond unit, amide-bond unit, thioether-bond unit, amine-bond unit, urethane-bond unit, or silyl unit in the part of hydrocarbon groups, and R<sub>14</sub> is a hydrocarbon group selected from the group consisting of an alkyl, cycloalkyl, alkenyl, aryl, or aralkyl group having 1 to 20 carbon atoms, a heterocyclic group having 4 to 20 carbon atoms, and a substituted hydrocarbon or heterocyclic group obtained by substituting part of hydrogens of the hydrocarbon group or heterocyclic group with a substituent group; and Me represents Cr, Co, Fe, Mn, Ni, Os, Ru,

V, Mo(X)(Q), Nb(X)(Q), Ti(X)(Q), V(X)(Q) or Zr(X)(Q) wherein X and Q are each independently selected from the group consisting of hydrogen, halogen, an alkyl group having 1 to 12 carbon atoms, ClO<sub>4</sub><sup>-</sup>, BF<sub>4</sub><sup>-</sup>, PF<sub>6</sub><sup>-</sup>, AsF<sub>6</sub><sup>-</sup>, SbF<sub>6</sub><sup>-</sup>, CH<sub>3</sub>COO<sup>-</sup>, CH<sub>3</sub>(C<sub>6</sub>H<sub>4</sub>)SO<sub>3</sub><sup>-</sup>, trifluoromethylsulfonate (CF<sub>3</sub>SO<sub>3</sub><sup>-</sup>), bis(trifluoromethylsulfonyl)imide ((CF<sub>3</sub>SO<sub>2</sub>)<sub>2</sub>N<sup>+</sup>), bis(perfluoroethylsulfonyl)imide ((CF<sub>3</sub>CF<sub>2</sub>SO<sub>2</sub>)<sub>2</sub>N<sup>+</sup>) and tris(trifluoromethylsulfonyl)methide ((CF<sub>3</sub>SO<sub>2</sub>)<sub>3</sub>C<sup>+</sup>); or having the formula

35 Cat<sub>1</sub>-An<sub>1</sub>,

or having the formula

Cat<sub>1</sub>-Bridge<sub>1</sub>-An<sub>1</sub>,

or having the formula

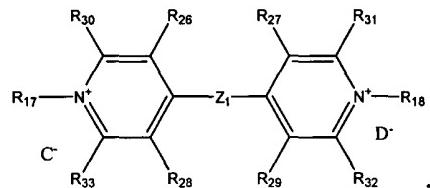
Cat<sub>1</sub>-Bridge<sub>1</sub>-An<sub>1</sub>-Bridge<sub>2</sub>-Cat<sub>2</sub>,

40 or having the formula

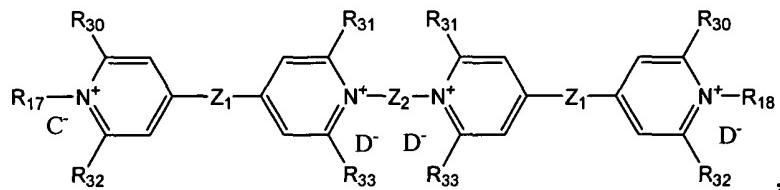
An<sub>2</sub>-Bridge<sub>2</sub>-Cat<sub>1</sub>-Bridge<sub>1</sub>-An<sub>1</sub>,

wherein Cat<sub>1</sub>-An<sub>1</sub> represents a charge transfer complex;

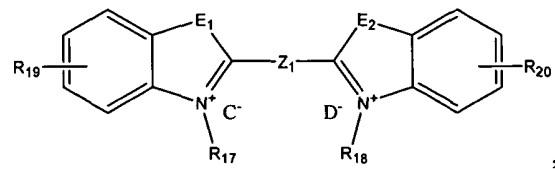
wherein Cat<sub>1</sub> and Cat<sub>2</sub> independently represent a radical having the structural formula



45 or having the structural formula

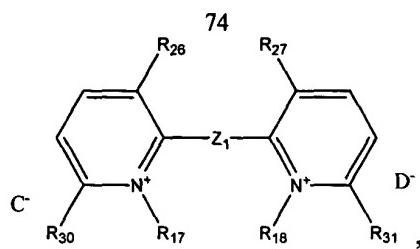


or having the structural formula

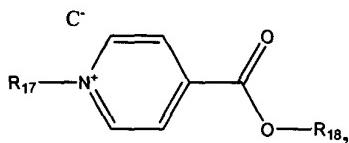


or having the structural formula

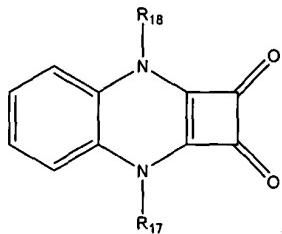
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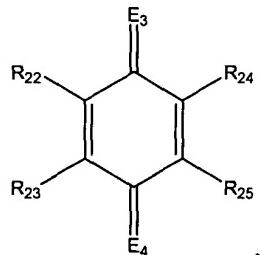
or having the structural formula



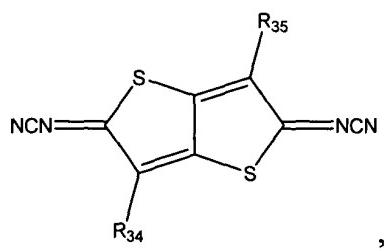
or having the structural formula



55 or having the structural formula



or having the structural formula

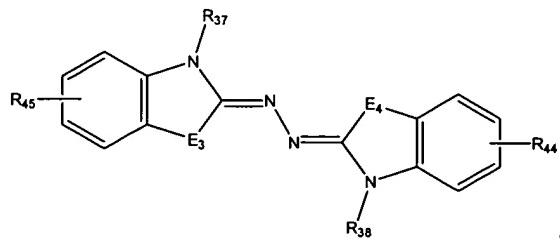


wherein R<sub>17</sub> and R<sub>18</sub> independently of one another denote C<sub>1</sub> to C<sub>18</sub>-alkyl, C<sub>2</sub> to C<sub>12</sub>-

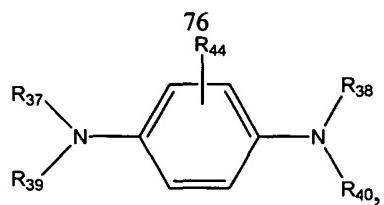
60 alkenyl, C<sub>3</sub> to C<sub>7</sub>-cycloalkyl, C<sub>7</sub> to C<sub>15</sub>-aralkyl or C<sub>6</sub> to C<sub>10</sub>-aryl or R<sub>17</sub> and R<sub>18</sub> together form a -(CH<sub>2</sub>)<sub>2</sub>-, -(CH<sub>2</sub>)<sub>3</sub>-, or -CH=CH- bridge, R<sub>19</sub>, R<sub>20</sub> and R<sub>22</sub> to R<sub>25</sub> independently of one another denote hydrogen, C<sub>1</sub> to C<sub>18</sub>-alkyl, C<sub>1</sub> to C<sub>4</sub>-alkoxy, halogen, cyano, nitro or

C<sub>1</sub> to C<sub>18</sub> -alkoxycarbonyl or R<sub>22</sub> and R<sub>23</sub> and/or R<sub>24</sub> and R<sub>25</sub> form a -CH=CH-CH=CH- bridge; R<sub>26</sub>, R<sub>27</sub>, R<sub>28</sub> and R<sub>29</sub> independently of one another denote hydrogen or, in pairs, a -(CH<sub>2</sub>)<sub>2</sub>-, -(CH<sub>2</sub>)<sub>3</sub>- or -CH=CH- bridge, E<sub>3</sub> and E<sub>4</sub> independently of one another denote O, N-CN, C(CN)<sub>2</sub> or N-C<sub>6</sub> - to C<sub>10</sub>-aryl, R<sub>34</sub> and R<sub>35</sub> independently denote hydrogen, C<sub>1</sub> to C<sub>18</sub> -alkyl, C<sub>1</sub> to C<sub>18</sub> -alkoxy, halogen, cyano, nitro, C<sub>1</sub> to C<sub>18</sub> -alkoxycarbonyl or C<sub>6</sub> to C<sub>10</sub> - aryl, R<sub>30</sub> to R<sub>33</sub> independently of one another denote hydrogen or C<sub>1</sub> to C<sub>6</sub> -alkyl, or R<sub>30</sub> and R<sub>26</sub> and/or R<sub>31</sub> and R<sub>27</sub> form a -CH=CH-CH=CH- bridge, E<sub>1</sub> and E<sub>2</sub> independently of one another denote O, S, NR<sub>36</sub> or C(R<sub>36</sub>)<sub>2</sub> or E<sub>1</sub> and E<sub>2</sub> together form a -N-(CH<sub>2</sub>)<sub>2</sub>-N- bridge, R<sub>36</sub> denotes C<sub>1</sub> to C<sub>18</sub> -alkyl, C<sub>2</sub> to C<sub>12</sub> -alkenyl, C<sub>4</sub> to C<sub>7</sub> -cycloalkyl, C<sub>7</sub> to C<sub>15</sub> - aralkyl or C<sub>6</sub> to C<sub>10</sub> -aryl, Z<sub>1</sub> denotes a direct bond, -CH=CH-, -C(CH<sub>3</sub>)=CH-, -C(CN)=CH-, -CCl=CCl-, -C(OH)=CH-, -CCl=CH-, -C≡C-, -CH=N-N=CH-, -C(CH<sub>3</sub>)=N-N=C(CH<sub>3</sub>)- or -CCl=N-N=CCl-, Z<sub>2</sub> denotes -(CH<sub>2</sub>)<sub>r</sub> or -CH<sub>2</sub>-C<sub>6</sub>H<sub>4</sub>-CH<sub>2</sub>-, r=1-10, C<sup>-</sup> is selected from the group consisting of bis(trifluoromethylsulfonyl)imide ((CF<sub>3</sub>SO<sub>2</sub>)<sub>2</sub>N<sup>-</sup>), bis(perfluoroethylsulfonyl)imide ((CF<sub>3</sub>CF<sub>2</sub>SO<sub>2</sub>)<sub>2</sub>N<sup>-</sup>) and tris(trifluoromethylsulfonyl)methide ((CF<sub>3</sub>SO<sub>2</sub>)<sub>3</sub>C<sup>-</sup>), and D<sup>-</sup> is selected from the group consisting of halogen anion, ClO<sub>4</sub><sup>-</sup>, BF<sub>4</sub><sup>-</sup>, PF<sub>6</sub><sup>-</sup>, AsF<sub>6</sub><sup>-</sup>, SbF<sub>6</sub><sup>-</sup>, CH<sub>3</sub>COO<sup>-</sup>, and CH<sub>3</sub>(C<sub>6</sub>H<sub>4</sub>)SO<sub>3</sub><sup>-</sup>, trifluoromethylsulfonate (CF<sub>3</sub>SO<sub>3</sub><sup>-</sup>), bis(trifluoromethylsulfonyl)imide ((CF<sub>3</sub>SO<sub>2</sub>)<sub>2</sub>N<sup>-</sup>), bis(perfluoroethylsulfonyl)imide ((CF<sub>3</sub>CF<sub>2</sub>SO<sub>2</sub>)<sub>2</sub>N<sup>-</sup>) and tris(trifluoromethylsulfonyl)methide ((CF<sub>3</sub>SO<sub>2</sub>)<sub>3</sub>C<sup>-</sup>), wherein bonding to the bridge member bridge<sub>1</sub> or bridge<sub>2</sub> is effected via one of the radicals R<sub>17</sub>-R<sub>36</sub>, and the radicals mentioned then represent a direct bond, and wherein An<sub>1</sub> and An<sub>2</sub> independently represent radicals having the structural formula:

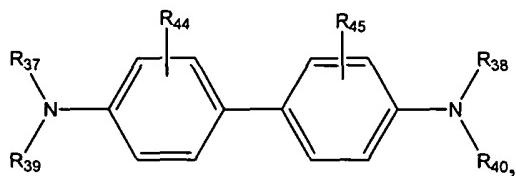
85



or having the structural formula

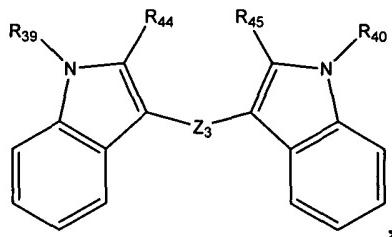


or having the structural formula

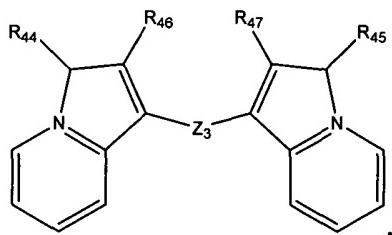


90

or having the structural formula

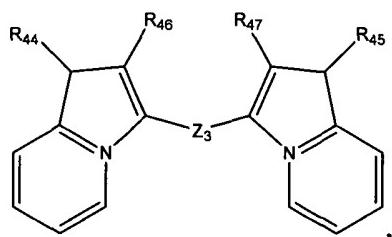


or having the structural formula

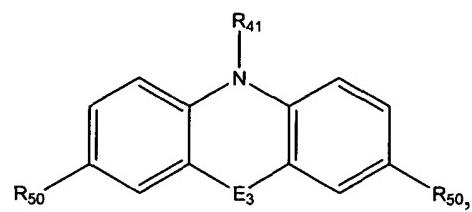


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or having the structural formula

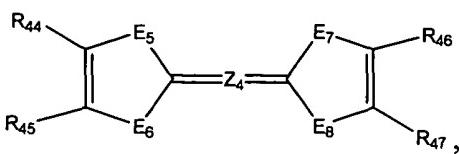


or having the structural formula



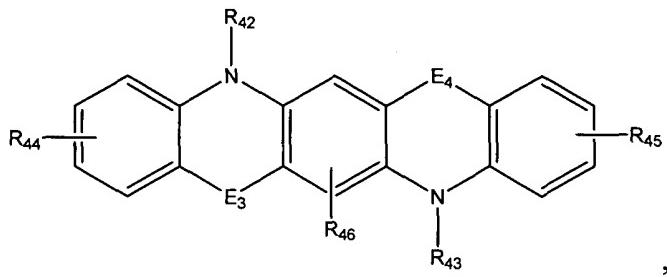
or having the structural formula

100



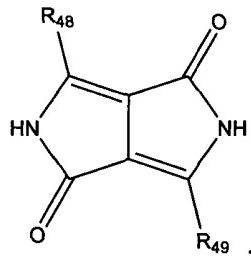
or having the structural formula

100



or having the structural formula

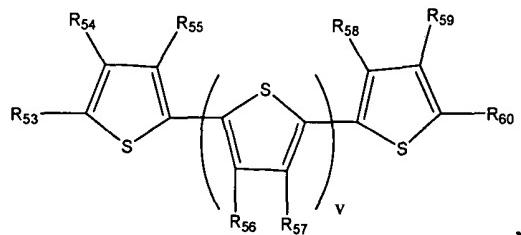
100



105

or having the structural formula

105



110

or wherein An<sub>1</sub> or An<sub>2</sub> independently represent a metal salt comprising titanium (III), vanadium (III), vanadium (IV), iron (II), cobalt (II), copper (I), silver (I), indium (I), tin (II), antimony (III), bismuth (III), cerium (III), samarium (II), dysprosium (II), ytterbium (II), or europium (II), wherein R<sub>37</sub> to R<sub>43</sub> independently of one another denote C<sub>1</sub> to C<sub>18</sub>-alkyl, C<sub>2</sub> to C<sub>12</sub>-alkenyl, C<sub>3</sub> to C<sub>7</sub>-cycloalkyl, C<sub>7</sub> to C<sub>15</sub>-aralkyl or C<sub>6</sub> to C<sub>10</sub>-aryl, and R<sub>41</sub> to R<sub>43</sub> additionally denote hydrogen, R<sub>44</sub> to R<sub>50</sub> independently of one another denote hydrogen, C<sub>1</sub> to C<sub>18</sub>-alkyl, C<sub>1</sub> to C<sub>18</sub>-alkoxy, halogen, cyano, nitro, C<sub>1</sub> to C<sub>18</sub>-alkoxycarbonyl or C<sub>6</sub> to C<sub>10</sub>-aryl and R<sub>48</sub> and R<sub>49</sub> additionally denote an optionally benzo-

115 fused aromatic or quasiaromatic five- or six-membered heterocyclic ring and R<sub>50</sub>  
additionally independently denotes N(R<sub>51</sub>)(R<sub>52</sub>), R<sub>44</sub> and R<sub>45</sub> and/or R<sub>46</sub> and R<sub>47</sub> form a -  
(CH<sub>2</sub>)<sub>3</sub>-, -(CH<sub>2</sub>)<sub>4</sub>-, -(CH<sub>2</sub>)<sub>5</sub>- or -CH=CH-CH=CH- bridge, Z<sub>3</sub> denotes a direct bond or a -  
CH=CH- or -N=N- bridge, =Z<sub>4</sub>= denotes a direct double bond or a =CH-CH= or =N-N= bridge,  
E<sub>3</sub> and E<sub>4</sub> independently of one another denote O, S, NR<sub>51</sub>, C(R<sub>51</sub>)(R<sub>52</sub>), C=O or  
120 SO<sub>2</sub>, E<sub>5</sub> to E<sub>8</sub> independently of one another denote S, Se or NR<sub>51</sub>, R<sub>51</sub> and R<sub>52</sub>  
independently of one another denote C<sub>1</sub> to C<sub>12</sub> -alkyl, C<sub>2</sub> to C<sub>8</sub> -alkenyl, C<sub>3</sub> to C<sub>7</sub> -  
cycloalkyl, C<sub>7</sub> to C<sub>15</sub> -aralkyl or C<sub>6</sub> to C<sub>10</sub> -aryl, R<sub>53</sub> to R<sub>60</sub> independently of one another  
denote hydrogen, C<sub>1</sub> - to C<sub>6</sub> -alkyl, C<sub>1</sub> to C<sub>18</sub> -alkoxy, cyano, C<sub>1</sub> to C<sub>18</sub> -alkoxycarbonyl or  
C<sub>6</sub> to C<sub>10</sub> -aryl, or R<sub>53</sub> and R<sub>54</sub> and R<sub>59</sub> and R<sub>60</sub> independently of one another together form  
125 a -(CH<sub>2</sub>)<sub>3</sub>-, -(CH<sub>2</sub>)<sub>4</sub>- or -CH=CH-CH=CH- bridge, v=0-10, wherein bonding to the bridge  
member Bridge<sub>1</sub> or Bridge<sub>2</sub> is effected by one of the radicals R<sub>37</sub> -R<sub>54</sub>, or R<sub>60</sub> and the  
radicals mentioned then represent a direct bond, and Bridge<sub>1</sub> or Bridge<sub>2</sub> independently  
represents a bridge member of the formula -(CH<sub>2</sub>)<sub>n</sub>- or -(Y<sub>1</sub>)<sub>s</sub>(CH<sub>2</sub>)<sub>m</sub>-(Y<sub>2</sub>)<sub>o</sub>-(CH<sub>2</sub>)<sub>p</sub>-(Y<sub>3</sub>)<sub>q</sub>-,  
each of which is optionally substituted by C<sub>1</sub> to C<sub>18</sub> -alkoxy, halogen or phenyl, Y<sub>1</sub> to Y<sub>3</sub>  
130 independently of one another independently represent O, S, NR<sub>61</sub>, COO, CONH,  
NHCONH, cyclopentanediyl, cyclohexanediyl, phenylene or naphthylene, beta-  
dicarbonyls, R<sub>61</sub> denotes C<sub>1</sub> to C<sub>6</sub> -alkyl, C<sub>2</sub> to C<sub>6</sub> -alkenyl, C<sub>4</sub> to C<sub>7</sub> -cycloalkyl, C<sub>7</sub> to C<sub>15</sub> -  
aralkyl or C<sub>6</sub> - to C<sub>10</sub> -aryl, n=0-12, m=0-8, p=0-12, o=0-6, q=0-1, and s=0-1.

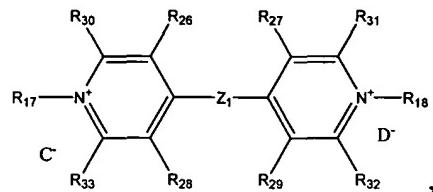
18. The electrolyte solution of claim 13, wherein said bifunctional redox dye comprises a redox active moiety comprising a pyrazoline, metallocene, phenylenediamine, benzidine, phenoxydine, phenothiazine, tetrafulvalene, phenazine, viologen or anthraquinone, and an energy receptor moiety comprising a benzophenone, benzotriazole, or cyanoacrylate.

19. The electrolyte solution of claim 11, further comprising at least one additive selected from the group consisting of non-ionic cosolvents, polymers, thixotropic agents, and UV stabilizers.

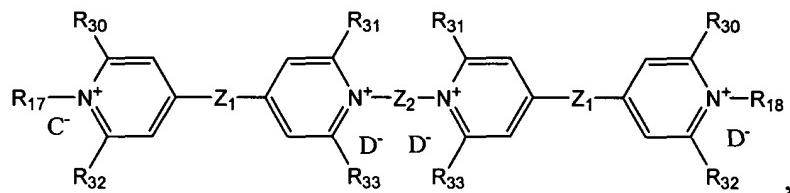
20. The electrolyte solution of claim 11, wherein said bifunctional redox dye comprises a compound having the formula



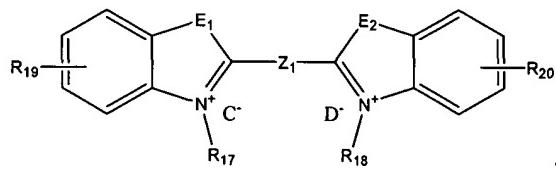
wherein M represents a metal salt comprising titanium (III), vanadium (III), vanadium (IV), iron (II), cobalt (II), copper (I), silver (I), indium (I), tin (II), antimony (III), bismuth (III), cerium (III), samarium (II), dysprosium (II), ytterbium (II), or europium (II);  
5 wherein Cat<sub>1</sub> represents a ligand having the structural formula



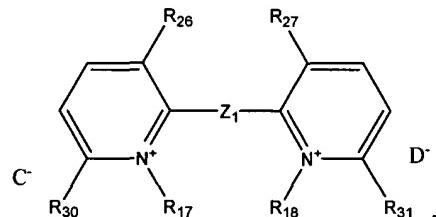
10 or having the structural formula



or having the structural formula

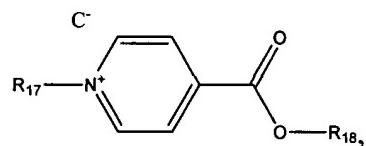


or having the structural formula

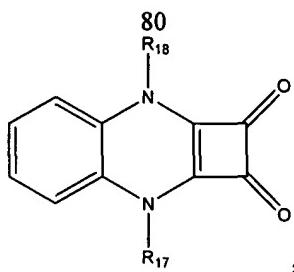


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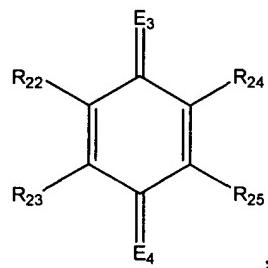
or having the structural formula



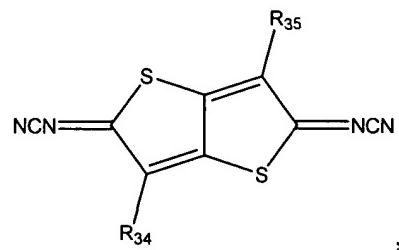
or having the structural formula



20 or having the structural formula



or having the structural formula



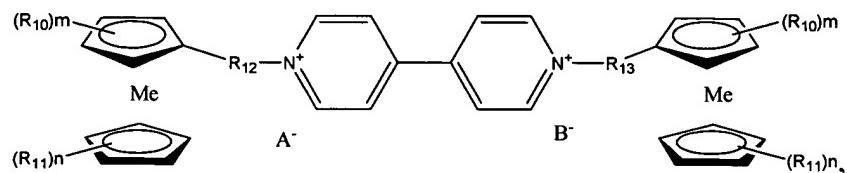
wherein R<sub>17</sub> and R<sub>18</sub> independently of one another denote C<sub>1</sub> to C<sub>18</sub>-alkyl, C<sub>2</sub> to C<sub>12</sub>-alkenyl, C<sub>3</sub> to C<sub>7</sub>-cycloalkyl, C<sub>7</sub> to C<sub>15</sub>-aralkyl or C<sub>6</sub> to C<sub>10</sub>-aryl or R<sub>17</sub> and R<sub>18</sub> together form a -(CH<sub>2</sub>)<sub>2</sub>-, -(CH<sub>2</sub>)<sub>3</sub>-, or -CH=CH-, R<sub>19</sub>, R<sub>20</sub> and R<sub>22</sub> to R<sub>25</sub> independently of one another denote hydrogen, C<sub>1</sub> to C<sub>18</sub>-alkyl, C<sub>1</sub> to C<sub>18</sub>-alkoxy, halogen, cyano, nitro or C<sub>1</sub> to C<sub>18</sub>-alkoxycarbonyl or R<sub>22</sub> and R<sub>23</sub> and/or R<sub>24</sub> and R<sub>25</sub> form a -CH=CH-CH=CH- bridge; R<sub>26</sub>, R<sub>27</sub>, R<sub>28</sub> and R<sub>29</sub> independently of one another denote hydrogen or, in pairs, a -(CH<sub>2</sub>)<sub>2</sub>-, -(CH<sub>2</sub>)<sub>3</sub>- or -CH=CH- bridge, E<sub>3</sub> and E<sub>4</sub> independently of one another denote O, N-CN, C(CN)<sub>2</sub> or N-C<sub>6</sub>- to C<sub>10</sub>-aryl, R<sub>34</sub> and R<sub>35</sub> independently denote hydrogen, C<sub>1</sub> to C<sub>18</sub>-alkyl, C<sub>1</sub> to C<sub>18</sub>-alkoxy, halogen, cyano, nitro, C<sub>1</sub> to C<sub>18</sub>-alkoxycarbonyl or C<sub>6</sub> to C<sub>10</sub>-aryl, R<sub>30</sub> to R<sub>33</sub> independently of one another denote hydrogen or C<sub>1</sub>-C<sub>6</sub>-alkyl, or R<sub>30</sub> and R<sub>26</sub> and/or R<sub>31</sub> and R<sub>27</sub> form a -CH=CH-CH=CH- bridge, E<sub>1</sub> and E<sub>2</sub> independently of one another denote O, S, NR<sub>36</sub> or C(R<sub>36</sub>)<sub>2</sub> or E<sub>1</sub> and E<sub>2</sub> together form a -N-(CH<sub>2</sub>)<sub>2</sub>-N- bridge, R<sub>36</sub> denotes C<sub>1</sub> to C<sub>18</sub>-alkyl, C<sub>2</sub> to C<sub>12</sub>-alkenyl, C<sub>4</sub> to C<sub>7</sub>-cycloalkyl, C<sub>7</sub> to C<sub>15</sub>-aralkyl or C<sub>6</sub> to C<sub>10</sub>-aryl, Z<sub>1</sub> denotes a direct bond, -CH=CH-, -C(CH<sub>3</sub>)=CH-,

81

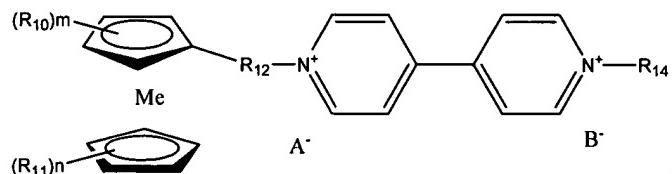
-C(CN)=CH-, -CCl=CCl-, -C(OH)=CH-, -CCl=CH-, -C≡C-, -CH=N-N=CH-, -C(CH<sub>3</sub>)=N-  
N=C(CH<sub>3</sub>)- or -CCl=N-N=CCl-, Z<sub>2</sub> denotes -(CH<sub>2</sub>)<sub>r</sub> or -CH<sub>2</sub>-C<sub>6</sub>H<sub>4</sub>-CH<sub>2</sub>-, r=1-10, C<sup>-</sup> is

- 40 selected from the group consisting of bis(trifluoromethylsulfonyl)imide ((CF<sub>3</sub>SO<sub>2</sub>)<sub>2</sub>N<sup>-</sup>),  
bis(perfluoroethylsulfonyl)imide ((CF<sub>3</sub>CF<sub>2</sub>SO<sub>2</sub>)<sub>2</sub>N<sup>-</sup>) and  
tris(trifluoromethylsulfonyl)methide ((CF<sub>3</sub>SO<sub>2</sub>)<sub>3</sub>C<sup>-</sup>), and D<sup>-</sup> is selected from the group  
consisting of halogen anion, ClO<sub>4</sub><sup>-</sup>, BF<sub>4</sub><sup>-</sup>, PF<sub>6</sub><sup>-</sup>, AsF<sub>6</sub><sup>-</sup>, SbF<sub>6</sub><sup>-</sup>, CH<sub>3</sub>COO<sup>-</sup>, and  
CH<sub>3</sub>(C<sub>6</sub>H<sub>4</sub>)SO<sub>3</sub><sup>-</sup>, trifluoromethylsulfonate (CF<sub>3</sub>SO<sub>3</sub><sup>-</sup>), bis(trifluoromethylsulfonyl)imide  
45 ((CF<sub>3</sub>SO<sub>2</sub>)<sub>2</sub>N<sup>-</sup>), bis(perfluoroethylsulfonyl)imide ((CF<sub>3</sub>CF<sub>2</sub>SO<sub>2</sub>)<sub>2</sub>N<sup>-</sup>) and  
tris(trifluoromethylsulfonyl)methide ((CF<sub>3</sub>SO<sub>2</sub>)<sub>3</sub>C<sup>-</sup>).

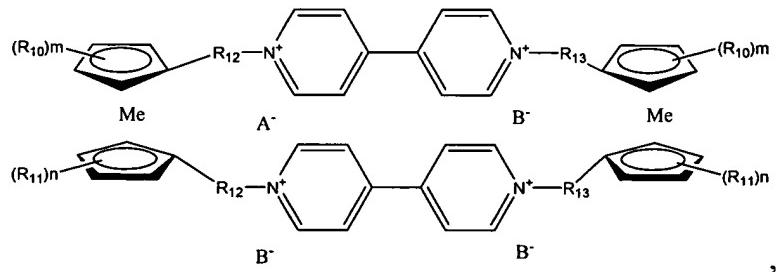
21. A compound having the structural formula



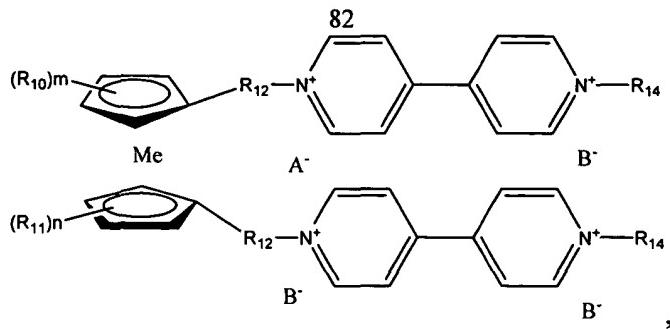
or having the structural formula



5 or having the structural formula

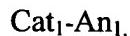


or having the structural formula



wherein  $A^-$  is selected from the group consisting of trifluoromethylsulfonate ( $CF_3SO_3^-$ ), bis(trifluoromethylsulfonyl)imide ( $(CF_3SO_2)_2N^+$ ), bis(perfluoroethylsulfonyl)imide ( $(CF_3CF_2SO_2)_2N^+$ ) and tris(trifluoromethylsulfonyl)methide ( $(CF_3SO_2)_3C^-$ );  $B^-$  is selected from the group consisting of a halogen anion,  $ClO_4^-$ ,  $BF_4^-$ ,  $PF_6^-$ ,  $AsF_6^-$ ,  $SbF_6^-$ ,  $CH_3COO^-$ , and  $CH_3(C_6H_4)SO_3^-$ , trifluoromethylsulfonate ( $CF_3SO_3^-$ ), bis(trifluoromethylsulfonyl)imide ( $(CF_3SO_2)_2N^+$ ), bis(perfluoroethylsulfonyl)imide ( $(CF_3CF_2SO_2)_2N^+$ ) and tris(trifluoromethylsulfonyl)methide ( $(CF_3SO_2)_3C^-$ ); wherein  $R_{10}$  and  $R_{11}$  are each independently a hydrocarbon group selected from the group consisting of an alkyl, alkenyl and aryl group having 1 to 10 carbon atoms, in the case where  $R_{10}$  or  $R_{11}$  is an aryl group, the aryl group forms a condensed ring together with a cyclopentadienyl ring; wherein  $m=0-4$ ; wherein  $n=0-4$ ; wherein  $R_{12}$  and  $R_{13}$  are each independently a hydrocarbon residue having 1 to 20 carbon atoms, or alkylene groups having ester-bond unit, ether-bond unit, amide-bond unit, thioether-bond unit, amine-bond unit, urethane-bond unit, or silyl unit in the part of hydrocarbon groups, and  $R_{14}$  is a hydrocarbon group selected from the group consisting of an alkyl, cycloalkyl, alkenyl, aryl, or aralkyl group having 1 to 20 carbon atoms, a heterocyclic group having 4 to 20 carbon atoms, and a substituted hydrocarbon or heterocyclic group obtained by substituting part of hydrogens of the hydrocarbon group or heterocyclic group with a substituent group; and Me represents Cr, Co, Fe, Mn, Ni, Os, Ru, V,  $Mo(X)(Q)$ ,  $Nb(X)(Q)$ ,  $Ti(X)(Q)$ ,  $V(X)(Q)$  or  $Zr(X)(Q)$  wherein X and Q are each independently selected from the group consisting of hydrogen, halogen, an alkyl group having 1 to 12 carbon atoms,  $ClO_4^-$ ,  $BF_4^-$ ,  $PF_6^-$ ,  $AsF_6^-$ ,  $SbF_6^-$ ,  $CH_3COO^-$ ,  $CH_3(C_6H_4)SO_3^-$ , trifluoromethylsulfonate ( $CF_3SO_3^-$ ), bis(trifluoromethylsulfonyl)imide ( $(CF_3SO_2)_2N^+$ ), bis(perfluoroethylsulfonyl)imide ( $(CF_3CF_2SO_2)_2N^+$ ) and tris(trifluoromethylsulfonyl)methide ( $(CF_3SO_2)_3C^-$ );

or having the formula



35 or having the formula



or having the formula



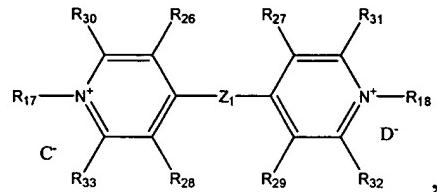
or having the formula



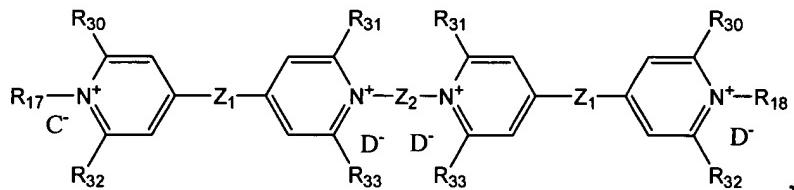
40

wherein  $\text{Cat}_1\text{-An}_1$  represents a charge transfer complex;

wherein  $\text{Cat}_1$  and  $\text{Cat}_2$  independently represent a radical having the structural formula

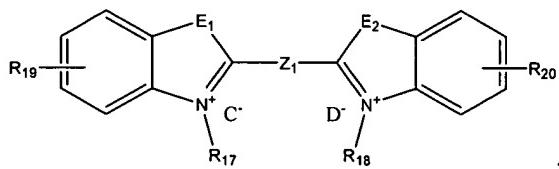


or having the structural formula

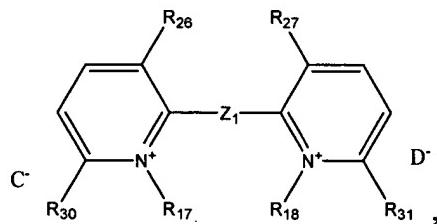


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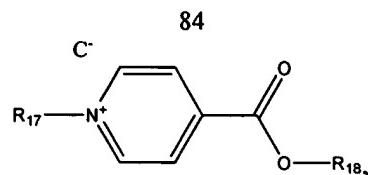
or having the structural formula



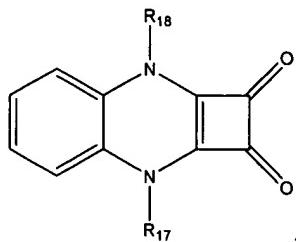
or having the structural formula



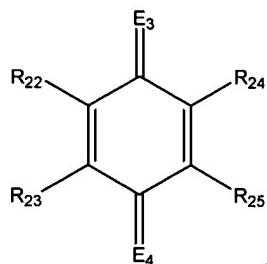
50 or having the structural formula



or having the structural formula

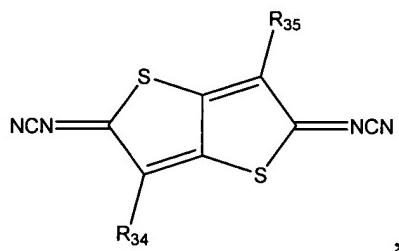


or having the structural formula



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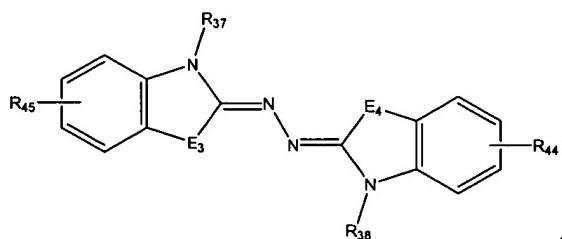
or having the structural formula



wherein R<sub>17</sub> and R<sub>18</sub> independently of one another denote C<sub>1</sub> to C<sub>18</sub>-alkyl, C<sub>2</sub> to C<sub>12</sub>-alkenyl, C<sub>3</sub> to C<sub>7</sub>-cycloalkyl, C<sub>7</sub> to C<sub>15</sub>-aralkyl or C<sub>6</sub> to C<sub>10</sub>-aryl or R<sub>17</sub> and R<sub>18</sub> together form a -(CH<sub>2</sub>)<sub>2</sub>-, -(CH<sub>2</sub>)<sub>3</sub>-, or -CH=CH- bridge, R<sub>19</sub>, R<sub>20</sub> and R<sub>22</sub> to R<sub>25</sub> independently of one another denote hydrogen, C<sub>1</sub> to C<sub>18</sub>-alkyl, C<sub>1</sub> to C<sub>4</sub>-alkoxy, halogen, cyano, nitro or C<sub>1</sub> to C<sub>18</sub>-alkoxycarbonyl or R<sub>22</sub> and R<sub>23</sub> and/or R<sub>24</sub> and R<sub>25</sub> form a -CH=CH-CH=CH-bridge; R<sub>26</sub>, R<sub>27</sub>, R<sub>28</sub> and R<sub>29</sub> independently of one another denote hydrogen or, in pairs, a -(CH<sub>2</sub>)<sub>2</sub>-, -(CH<sub>2</sub>)<sub>3</sub>- or -CH=CH- bridge, E<sub>3</sub> and E<sub>4</sub> independently of one another denote O, N-CN, C(CN)<sub>2</sub> or N-C<sub>6</sub>- to C<sub>10</sub>-aryl, R<sub>34</sub> and R<sub>35</sub> independently denote hydrogen, C<sub>1</sub> to C<sub>18</sub>-alkyl, C<sub>1</sub> to C<sub>18</sub>-alkoxy, halogen, cyano, nitro, C<sub>1</sub> to C<sub>18</sub>-alkoxycarbonyl or C<sub>6</sub> to C<sub>10</sub>-aryl, R<sub>30</sub> to R<sub>33</sub> independently of one another denote hydrogen or C<sub>1</sub> to C<sub>6</sub>-alkyl, or R<sub>30</sub>

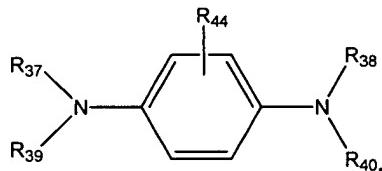
85

and R<sub>26</sub> and/or R<sub>31</sub> and R<sub>27</sub> form a -CH=CH-CH=CH- bridge, E<sub>1</sub> and E<sub>2</sub> independently of one another denote O, S, NR<sub>36</sub> or C(R<sub>36</sub>)<sub>2</sub> or E<sub>1</sub> and E<sub>2</sub> together form a -N-(CH<sub>2</sub>)<sub>2</sub>-N-bridge, R<sub>36</sub> denotes C<sub>1</sub> to C<sub>18</sub>-alkyl, C<sub>2</sub> to C<sub>12</sub>-alkenyl, C<sub>4</sub> to C<sub>7</sub>-cycloalkyl, C<sub>7</sub> to C<sub>15</sub>-aralkyl or C<sub>6</sub> to C<sub>10</sub>-aryl, Z<sub>1</sub> denotes a direct bond, -CH=CH-, -C(CH<sub>3</sub>)=CH-, -C(CN)=CH-, -CCl=CCl-, -C(OH)=CH-, -CCl=CH-, -C≡C-, -CH=N-N=CH-, -C(CH<sub>3</sub>)=N-N=C(CH<sub>3</sub>)- or -CCl=N-N=CCl-, Z<sub>2</sub> denotes -(CH<sub>2</sub>)<sub>r</sub> or -CH<sub>2</sub>-C<sub>6</sub>H<sub>4</sub>-CH<sub>2</sub>-, r=1-10, C<sup>-</sup> is selected from the group consisting of bis(trifluoromethylsulfonyl)imide ((CF<sub>3</sub>SO<sub>2</sub>)<sub>2</sub>N<sup>-</sup>), bis(perfluoroethylsulfonyl)imide ((CF<sub>3</sub>CF<sub>2</sub>SO<sub>2</sub>)<sub>2</sub>N<sup>-</sup>) and tris(trifluoromethylsulfonyl)methide ((CF<sub>3</sub>SO<sub>2</sub>)<sub>3</sub>C<sup>-</sup>), and D<sup>-</sup> is selected from the group consisting of halogen anion, ClO<sub>4</sub><sup>-</sup>, BF<sub>4</sub><sup>-</sup>, PF<sub>6</sub><sup>-</sup>, AsF<sub>6</sub><sup>-</sup>, SbF<sub>6</sub><sup>-</sup>, CH<sub>3</sub>COO<sup>-</sup>, and CH<sub>3</sub>(C<sub>6</sub>H<sub>4</sub>)SO<sub>3</sub><sup>-</sup>, trifluoromethylsulfonate (CF<sub>3</sub>SO<sub>3</sub><sup>-</sup>), bis(trifluoromethylsulfonyl)imide ((CF<sub>3</sub>SO<sub>2</sub>)<sub>2</sub>N<sup>-</sup>), bis(perfluoroethylsulfonyl)imide ((CF<sub>3</sub>CF<sub>2</sub>SO<sub>2</sub>)<sub>2</sub>N<sup>-</sup>) and tris(trifluoromethylsulfonyl)methide ((CF<sub>3</sub>SO<sub>2</sub>)<sub>3</sub>C<sup>-</sup>), wherein bonding to the bridge member bridge<sub>1</sub> or bridge<sub>2</sub> is effected via one of the radicals R<sub>17</sub>-R<sub>36</sub>, and the radicals mentioned then represent a direct bond, and wherein An<sub>1</sub> and An<sub>2</sub> independently represent radicals having the structural formula:

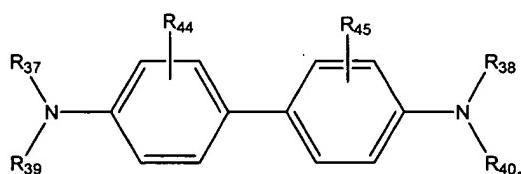


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or having the structural formula

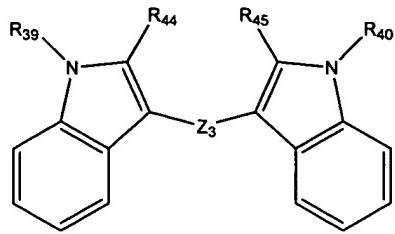


or having the structural formula

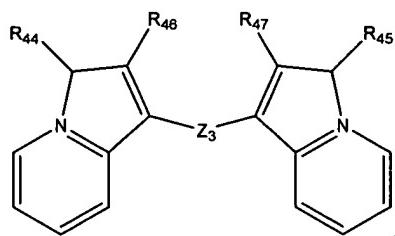


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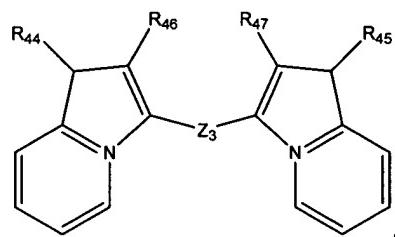
90 or having the structural formula



or having the structural formula

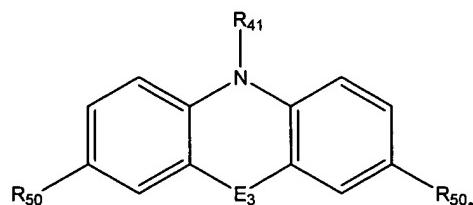


or having the structural formula

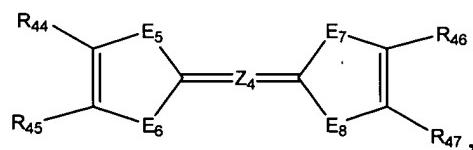


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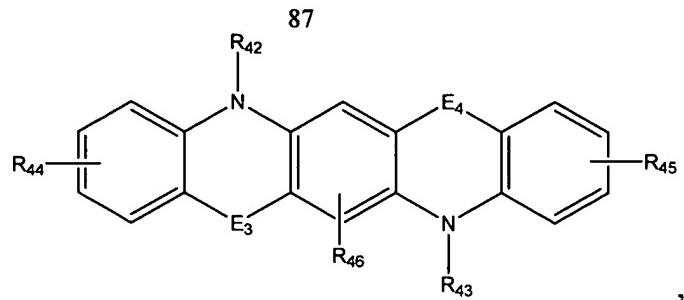
or having the structural formula



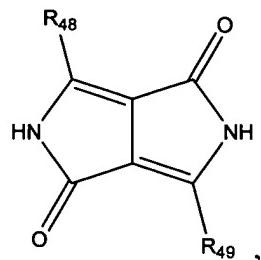
or having the structural formula



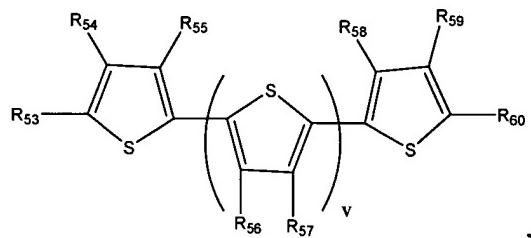
100 or having the structural formula



or having the structural formula



or having the structural formula

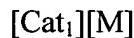


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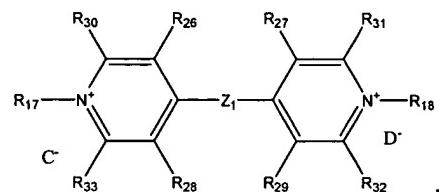
or wherein An<sub>1</sub> or An<sub>2</sub> independently represent a metal salt comprising titanium (III), vanadium (III), vanadium (IV), iron (II), cobalt (II), copper (I), silver (I), indium (I), tin (II), antimony (III), bismuth (III), cerium (III), samarium (II), dysprosium (II), ytterbium (II), or europium (II), wherein R<sub>37</sub> to R<sub>43</sub> independently of one another denote C<sub>1</sub> to C<sub>18</sub>-alkyl, C<sub>2</sub> to C<sub>12</sub>-alkenyl, C<sub>3</sub> to C<sub>7</sub>-cycloalkyl, C<sub>7</sub> to C<sub>15</sub>-aralkyl or C<sub>6</sub> to C<sub>10</sub>-aryl, and R<sub>41</sub> to R<sub>43</sub> additionally denote hydrogen, R<sub>44</sub> to R<sub>50</sub> independently of one another denote hydrogen, C<sub>1</sub> to C<sub>18</sub>-alkyl, C<sub>1</sub> to C<sub>18</sub>-alkoxy, halogen, cyano, nitro, C<sub>1</sub> to C<sub>18</sub>-alkoxycarbonyl or C<sub>6</sub> to C<sub>10</sub>-aryl and R<sub>48</sub> and R<sub>49</sub> additionally denote an optionally benzo-fused aromatic or quasiaromatic five- or six-membered heterocyclic ring and R<sub>50</sub> additionally independently denotes N(R<sub>51</sub>)(R<sub>52</sub>), R<sub>44</sub> and R<sub>45</sub> and/or R<sub>46</sub> and R<sub>47</sub> form a -(CH<sub>2</sub>)<sub>3</sub>-, -(CH<sub>2</sub>)<sub>4</sub>-, -(CH<sub>2</sub>)<sub>5</sub>- or -CH=CH-CH=CH- bridge, Z<sub>3</sub> denotes a direct bond or a -CH=CH- or -N=N- bridge, =Z<sub>4</sub>= denotes a direct double bond or a =CH-CH= or =N-N= bridge, E<sub>3</sub> and E<sub>4</sub> independently of one another denote O, S, NR<sub>51</sub>, C(R<sub>51</sub>)(R<sub>52</sub>), C=O or

SO<sub>2</sub>, E<sub>5</sub> to E<sub>8</sub> independently of one another denote S, Se or NR<sub>51</sub>, R<sub>51</sub> and R<sub>52</sub>  
 120 independently of one another denote C<sub>1</sub> to C<sub>12</sub>-alkyl, C<sub>2</sub> to C<sub>8</sub>-alkenyl, C<sub>3</sub> to C<sub>7</sub>-cycloalkyl, C<sub>7</sub> to C<sub>15</sub>-aralkyl or C<sub>6</sub> to C<sub>10</sub>-aryl, R<sub>53</sub> to R<sub>60</sub> independently of one another denote hydrogen, C<sub>1</sub> to C<sub>6</sub>-alkyl, C<sub>1</sub> to C<sub>18</sub>-alkoxy, cyano, C<sub>1</sub> to C<sub>18</sub>-alkoxycarbonyl or C<sub>6</sub> to C<sub>10</sub>-aryl, or R<sub>53</sub> and R<sub>54</sub> and R<sub>59</sub> and R<sub>60</sub> independently of one another together form a -(CH<sub>2</sub>)<sub>3</sub>-, -(CH<sub>2</sub>)<sub>4</sub>- or -CH=CH-CH=CH- bridge, v=0-10, wherein bonding to the bridge member Bridge<sub>1</sub> or Bridge<sub>2</sub> is effected by one of the radicals R<sub>37</sub>-R<sub>54</sub>, or R<sub>60</sub> and the radicals mentioned then represent a direct bond, and Bridge<sub>1</sub> or Bridge<sub>2</sub> independently represents a bridge member of the formula -(CH<sub>2</sub>)<sub>n</sub>- or -(Y<sub>1</sub>)<sub>s</sub>(CH<sub>2</sub>)<sub>m</sub>-(Y<sub>2</sub>)<sub>o</sub>-(CH<sub>2</sub>)<sub>p</sub>-(Y<sub>3</sub>)<sub>q</sub>-, each of which is optionally substituted by C<sub>1</sub> to C<sub>18</sub>-alkoxy, halogen or phenyl, Y<sub>1</sub> to Y<sub>3</sub> independently of one another independently represent O, S, NR<sub>61</sub>, COO, CONH,  
 125 NHCONH, cyclopentanediyI, cyclohexanediyI, phenylene or naphthylene, beta-dicarbonyls, R<sub>61</sub> denotes C<sub>1</sub> to C<sub>6</sub>-alkyl, C<sub>2</sub> to C<sub>6</sub>-alkenyl, C<sub>4</sub> to C<sub>7</sub>-cycloalkyl, C<sub>7</sub> to C<sub>15</sub>-aralkyl or C<sub>6</sub> to C<sub>10</sub>-aryl, n=0-12, m=0-8, p=0-12, o=0-6, q=0-1, and s=0-1.

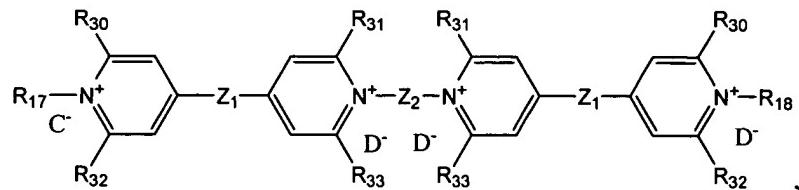
22. A compound having the structure the formula, wherein said bifunctional redox dye comprises a compound having the formula



wherein M represents a metal salt comprising titanium (III), vanadium (III), vanadium (IV), iron (II), cobalt (II), copper (I), silver (I), indium (I), tin (II), antimony (III), bismuth (III), cerium (III), samarium (II), dysprosium (II), ytterbium (II), or europium (II);  
 5 wherein Cat<sub>1</sub> represents a ligand having the structural formula

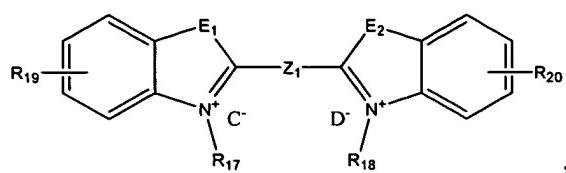


10 or having the structural formula

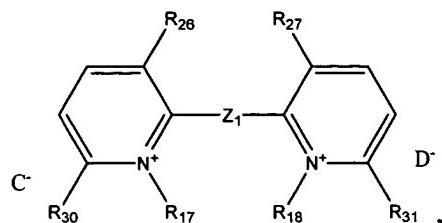


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or having the structural formula

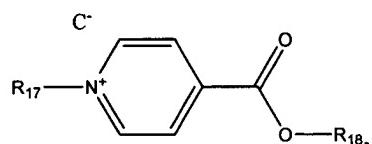


or having the structural formula

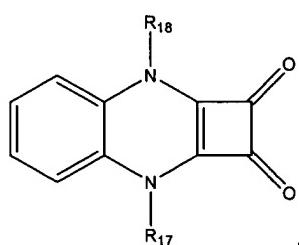


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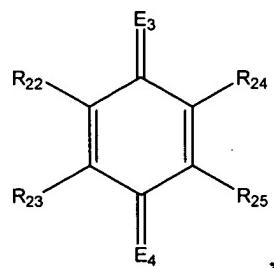
or having the structural formula



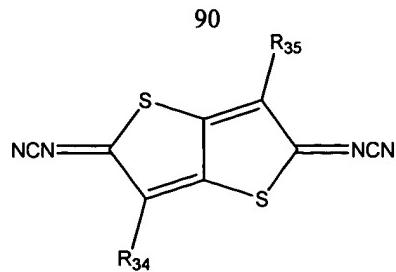
or having the structural formula



20 or having the structural formula



or having the structural formula



wherein R<sub>17</sub> and R<sub>18</sub> independently of one another denote C<sub>1</sub> to C<sub>18</sub>-alkyl, C<sub>2</sub> to C<sub>12</sub>-alkenyl, C<sub>3</sub> to C<sub>7</sub>-cycloalkyl, C<sub>7</sub> to C<sub>15</sub>-aralkyl or C<sub>6</sub> to C<sub>10</sub>-aryl or R<sub>17</sub> and R<sub>18</sub> together form a -(CH<sub>2</sub>)<sub>2</sub>-, -(CH<sub>2</sub>)<sub>3</sub>-, or -CH=CH-, R<sub>19</sub>, R<sub>20</sub> and R<sub>22</sub> to R<sub>25</sub> independently of one another denote hydrogen, C<sub>1</sub> to C<sub>18</sub>-alkyl, C<sub>1</sub> to C<sub>18</sub>-alkoxy, halogen, cyano, nitro or C<sub>1</sub> to C<sub>18</sub>-alkoxycarbonyl or R<sub>22</sub> and R<sub>23</sub> and/or R<sub>24</sub> and R<sub>25</sub> form a -CH=CH-CH=CH- bridge; R<sub>26</sub>, R<sub>27</sub>, R<sub>28</sub> and R<sub>29</sub> independently of one another denote hydrogen or, in pairs, a -(CH<sub>2</sub>)<sub>2</sub>-, -(CH<sub>2</sub>)<sub>3</sub>- or -CH=CH- bridge, E<sub>3</sub> and E<sub>4</sub> independently of one another denote O, N-CN, C(CN)<sub>2</sub> or N-C<sub>6</sub>- to C<sub>10</sub>-aryl, R<sub>34</sub> and R<sub>35</sub> independently denote hydrogen, C<sub>1</sub> to C<sub>18</sub>-alkyl, C<sub>1</sub> to C<sub>18</sub>-alkoxy, halogen, cyano, nitro, C<sub>1</sub> to C<sub>18</sub>-alkoxycarbonyl or C<sub>6</sub> to C<sub>10</sub>-aryl, R<sub>30</sub> to R<sub>33</sub> independently of one another denote hydrogen or C<sub>1</sub>-C<sub>6</sub>-alkyl, or R<sub>30</sub> and R<sub>26</sub> and/or R<sub>31</sub> and R<sub>27</sub> form a -CH=CH-CH=CH- bridge, E<sub>1</sub> and E<sub>2</sub> independently of one another denote O, S, NR<sub>36</sub> or C(R<sub>36</sub>)<sub>2</sub> or E<sub>1</sub> and E<sub>2</sub> together form a -N-(CH<sub>2</sub>)<sub>2</sub>-N- bridge, R<sub>36</sub> denotes C<sub>1</sub> to C<sub>18</sub>-alkyl, C<sub>2</sub> to C<sub>12</sub>-alkenyl, C<sub>4</sub> to C<sub>7</sub>-cycloalkyl, C<sub>7</sub> to C<sub>15</sub>-aralkyl or C<sub>6</sub> to C<sub>10</sub>-aryl, Z<sub>1</sub> denotes a direct bond, -CH=CH-, -C(CH<sub>3</sub>)=CH-, -C(CN)=CH-, -CCl=CCl-, -C(OH)=CH-, -CCl=CH-, -C≡C-, -CH=N-N=CH-, -C(CH<sub>3</sub>)=N-N=C(CH<sub>3</sub>)- or -CCl=N-N=CCl-, Z<sub>2</sub> denotes -(CH<sub>2</sub>)<sub>r</sub> or -CH<sub>2</sub>-C<sub>6</sub>H<sub>4</sub>-CH<sub>2</sub>-, r=1-10, C<sup>-</sup> is selected from the group consisting of bis(trifluoromethylsulfonyl)imide ((CF<sub>3</sub>SO<sub>2</sub>)<sub>2</sub>N<sup>-</sup>), bis(perfluoroethylsulfonyl)imide ((CF<sub>3</sub>CF<sub>2</sub>SO<sub>2</sub>)<sub>2</sub>N<sup>-</sup>) and tris(trifluoromethylsulfonyl)methide ((CF<sub>3</sub>SO<sub>2</sub>)<sub>3</sub>C<sup>-</sup>), and D<sup>-</sup> is selected from the group consisting of halogen anion, ClO<sub>4</sub><sup>-</sup>, BF<sub>4</sub><sup>-</sup>, PF<sub>6</sub><sup>-</sup>, AsF<sub>6</sub><sup>-</sup>, SbF<sub>6</sub><sup>-</sup>, CH<sub>3</sub>COO<sup>-</sup>, and CH<sub>3</sub>(C<sub>6</sub>H<sub>4</sub>)SO<sub>3</sub><sup>-</sup>, trifluoromethylsulfonate (CF<sub>3</sub>SO<sub>3</sub><sup>-</sup>), bis(trifluoromethylsulfonyl)imide ((CF<sub>3</sub>SO<sub>2</sub>)<sub>2</sub>N<sup>-</sup>), bis(perfluoroethylsulfonyl)imide ((CF<sub>3</sub>CF<sub>2</sub>SO<sub>2</sub>)<sub>2</sub>N<sup>-</sup>) and tris(trifluoromethylsulfonyl)methide ((CF<sub>3</sub>SO<sub>2</sub>)<sub>3</sub>C<sup>-</sup>).

23. A method for filling an empty electrooptic device with fluid comprising warm ionic liquid electrolyte solution, the device having relatively closely spaced plates, each

plate having an inwardly facing conductive surface, the plates being sealed around their periphery by a seal that encloses an area of each plate, comprising:

- (a) introducing a small opening into the seal of an empty device;
- (b) placing the empty device into a chamber along with a container of fluid comprising ionic liquid electrolyte solution;
- (c) evacuating the chamber;
- (d) lowering the empty device into the fluid such that the opening in the seal is located under the surface of the fluid;
- (e) warming at least a portion of the fluid to a temperature of at least 40°C;
- (f) exposing the fluid to a gas pressure greater than the pressure in the empty device to send the warm fluid into the device; and
- (g) sealing the gap in the peripheral seal of the device.